Integration of a µCAT propulsion system and a PhoneSat bus into a 1.5U CubeSat

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NASA Ames Research Center and the George Washington University have developed an electric propulsion subsystem that can be integrated into the PhoneSat bus. Experimental tests have shown a reliable performance by firing three different thrusters at various frequencies in vacuum conditions. The three thrusters were controlled by a SmartPhone that was running the PhoneSat software. The subsystem is fully operational and it requires low average power to function (about 0.1 W). The interface consists of a microcontroller that sends a trigger pulses to the PPU (Plasma Processing Unit), which is responsible for the thruster operation.

Frequencies ranging from 1 to 50Hz have been tested, showing a strong flexibility. A SmartPhone acts as the main user interface for the selection of commands that control the entire system. The micro cathode arc thruster (µCAT) provides a high I_{sp} of 3000s that allows a 4kg satellite to obtain a ΔV of 300m/s. The system mass is only 200g with a total volume of 200cm^3. The propellant is based on a solid cylinder made of Titanium, which is the cathode at the same time. This simplicity in the design avoids miniaturization and manufacturing problems. The characteristics of this thruster allow an array of µCATs to perform attitude control and orbital correction maneuvers that will open the door for the implementation of an extensive collection of new mission concepts and space applications for CubeSats

NASA Ames is currently working on the integration of the system to fit the thrusters and PPU inside a 1.5U CubeSat together with the PhoneSat bus. The first step will be the assembly of the PPU and two thrusters into one single PCB that will fit inside a CubeSat structure. After that, the system will be integrated with the already existing PhoneSat bus into a 1.5U CubeSat. This satellite is intended to be deployed from the ISS in 2015 and test the functionality of the thrusters by spinning the satellite around its long axis and measure the rotational speed with the phone gyros.

This test flight will raise the TRL of the propulsion system from 5 to 7 and will be a first test for further CubeSats with propulsion systems, a key subsystem for long duration or interplanetary CubeSat missions.